

A Consultant's Perspective on **GREEN** Remediation

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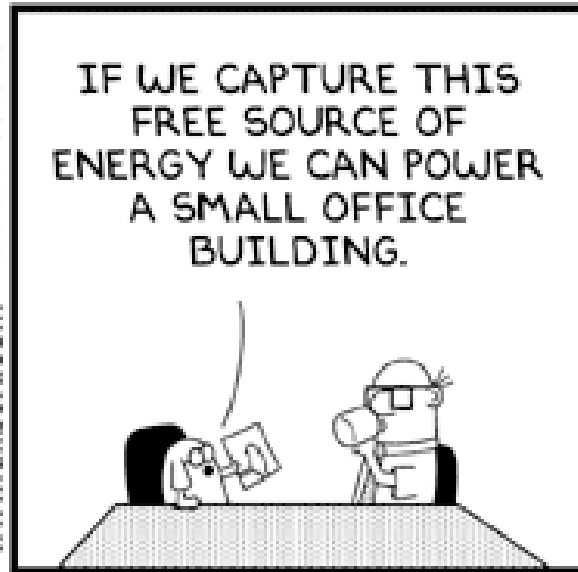
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A Consultant's Role



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Practical (?) Advice You Can Use!

What Does Green Remediation Mean?

- Sustainable Remediation Forum (SuRF) conducted short, informal and unscientific survey of regulatory perspective
- 163 contacted, 60 responses
- 15 Federal, 36 state, one Canadian, 8 anonymous responded

.....and the survey said...

What Does Green Remediation Mean?

- 79% had heard of it
- Range of understanding of what it is
- 43% might support it, with reservations
- No one would reject it out of hand
- 14% said it should be required
- More said it should be encouraged
- 39% said it should not be an evaluation criterion
- It should not be regulated by agencies
- 69% were not aware of it being used for remedy selection

You Got It?

So what is It.....

- Is more than just GHG reduction
- Considers H&S (risk in remedy)
- Considers community needs
- Conserves or reuses resources
- Maintains or builds new environmental or sustainable infrastructure

...It Is.....

Green Remediation

.....a framework to make good practical decisions that:

- Balances societal and regulatory goals
- Is not focused on picking the right “technology”
- Balances between what is good for the community and the environment against absolute remedial goals

Barriers To Accepting Green Remediation

- *Societal barriers are due to:*
 - *Little knowledge of sustainability principles*
 - *Current established process for remedy selection is known and understood*
 - *Little knowledge of the reliability of sustainable remedies*
 - *Little understanding of cost-benefit of the remedies vs. other societal risks or goals*

Barriers To Accepting Green Remediation

- Technical barriers
 - Universal definition of sustainable remediation is lacking
 - Metrics are not clear
 - Guidance is lacking
 - Resources are distributed and variable
 - Validation of sustainable remedies (cases studies) are few

Barriers To Accepting Green Remediation

- Organizational barriers:
 - **Economic – the business case**
 - Incremental cost vs outcome
 - Must be a level playing field
 - **Organizational**
 - Type (Government, Industry) have different mandates
 - Clarity of goals vs mission, valued and measured by the leaders

Barriers To Accepting Green Remediation

- Regulatory
 - Survey Results
 - Not widely understood, or understood differently
 - Current regulations
 - Does not explicitly include sustainability evaluation, but does not preclude it

The Consultant's Perspective

- Opportunity to develop practical, and strategic remedies that are more holistic
- Challenge is to convince stakeholders that they can do so!



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CASE STUDIES

SOMERSWORTH LANDFILL

Background

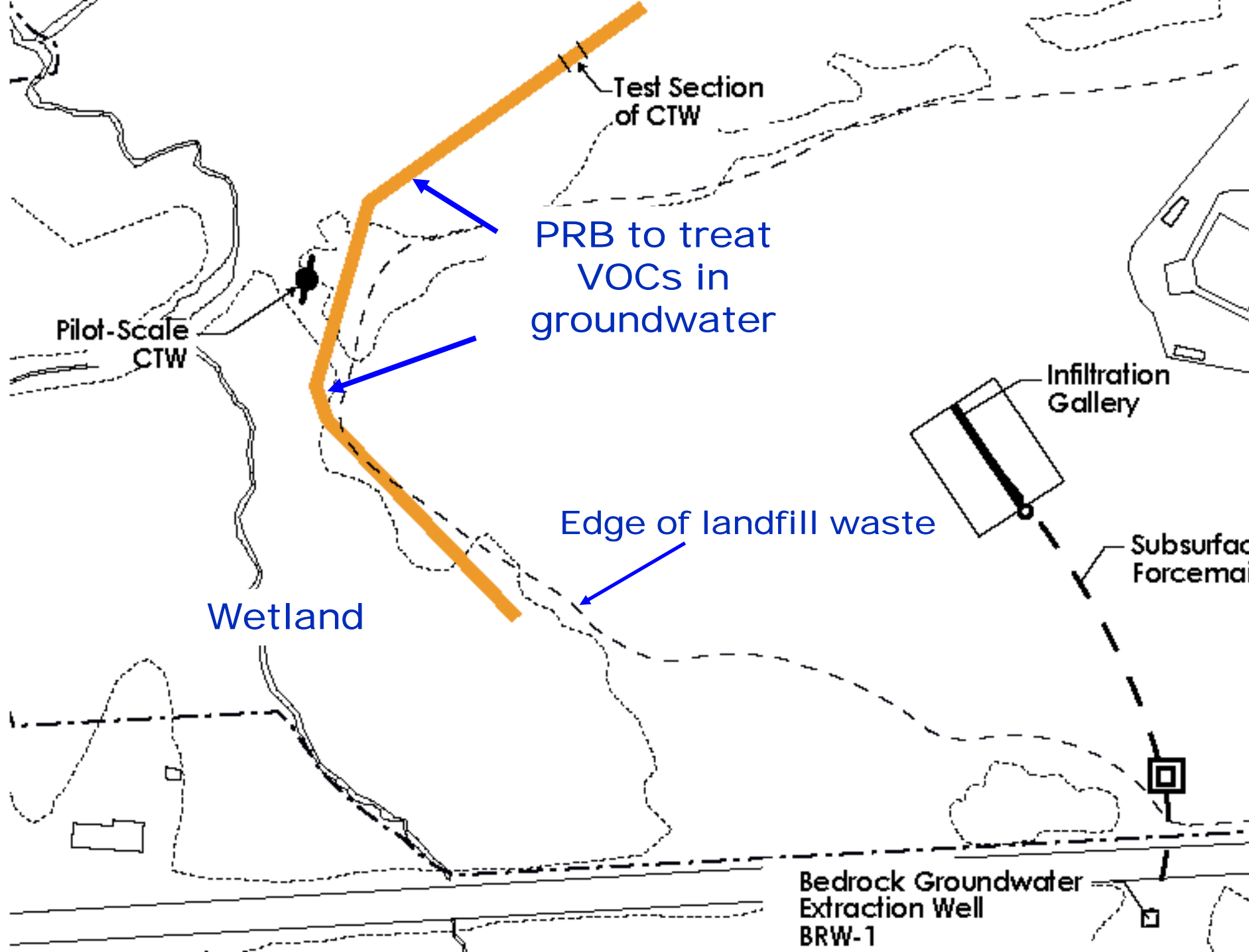
- 26-acre disposal site operated by City of Somersworth, New Hampshire
- Operated from mid-1930s, converted to landfill 1958-residential, commercial, and industrial wastes
- U.S. EPA-recommended traditional presumptive pump and treat (P&T)/waste encapsulation
- Remedy Cost Estimate: >\$16 (capital cost)
- Initial goal - cheaper alternative to attain risk and regulatory compliance objectives as outlined in Record of Decision (ROD)

EPA Remedy Implications

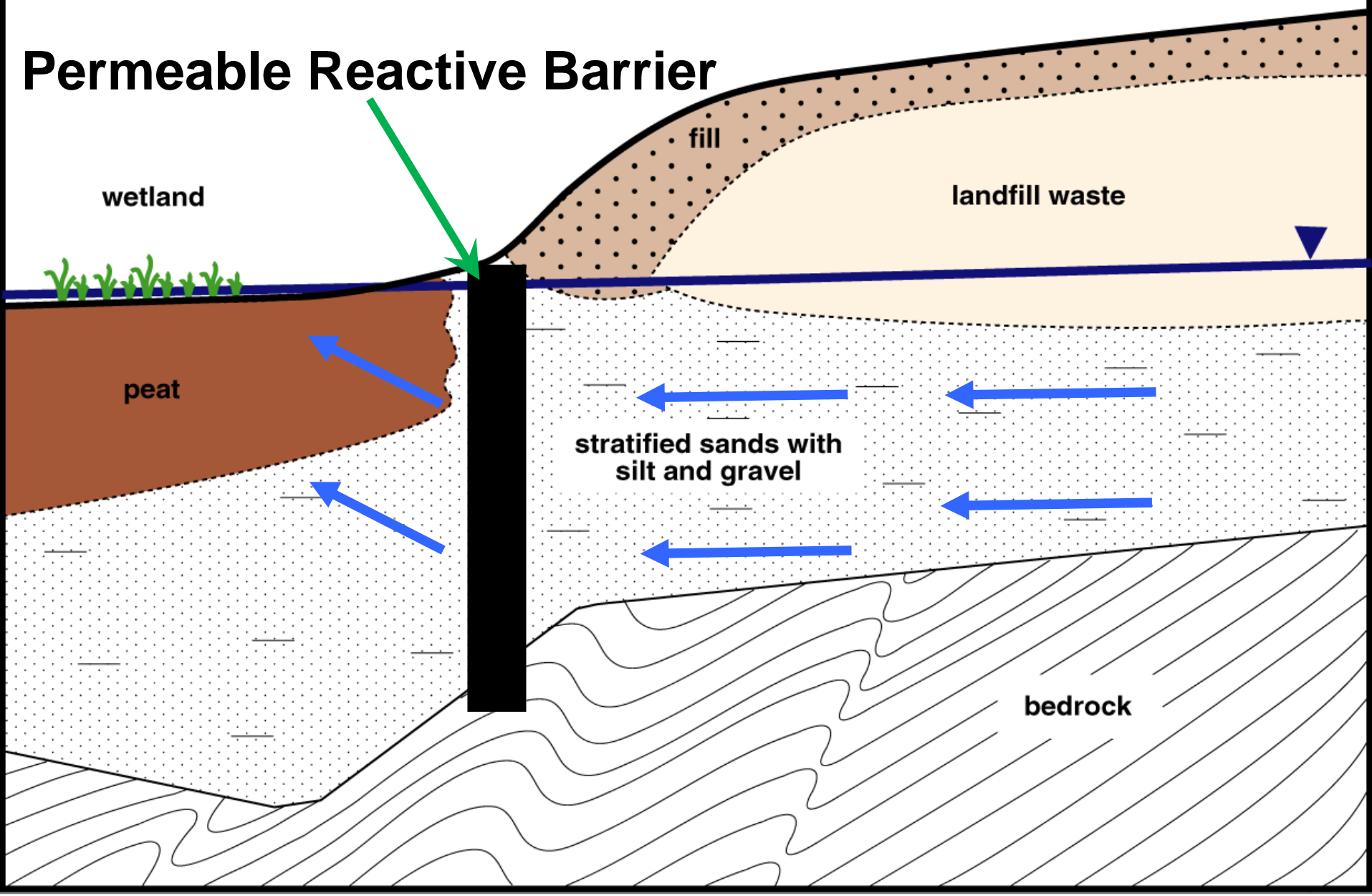
- Expensive
- Would have required
 - upgradient groundwater diversion trench
 - a soil-bentonite slurry wall surrounding the entire landfill
 - P&T system
 - Sludge disposal (Hazardous)
 - RCRA Cap
 - Negative impact to wetland (dewatering)

Alternative Remedy

- Downgradient permeable reactive barrier (ZVI) on edge of landfill
- Natural cap to allow infiltration through landfill waste
- Minimal pumping from bedrock
- Use of passive samplers
- \$5.5 million in reduced capital cost
- \$1.3 million in reduced O&M cost
- \$10.5 million in deferred cost (25 years)



Permeable Reactive Barrier



Sustainability Metrics

- Significant reduction in energy/GHG
 - Minimum construction/associated traffic
 - Passive system
 - P&T component limited to small amount of bedrock gw extraction and infiltration behind PRB
 - No hazardous sludge collection and disposal
 - Passive sampling
- Maintain/enhanced natural system
 - Wetlands maintained
 - Community enjoyment
 - Use of scrap metal
 - Enhanced natural degradation process in source and downgradient (source/plume treatment)
 - Methane generation consumed (via natural cap)
- Regulatory Acceptance

Somersworth Conclusions

- Project was initiated long before Green Remediation was in vogue
- Got to the right sustainability end points but driven there by cost considerations
- Are sustainable remediation systems inherently more cost effective too?

AEROSPACE MANUFACTURING FACILITY SAN DIEGO, CA

Aerospace Manufacturing Facility

- Shallow saline groundwater: “flat” gradient
- PCE concentrations indicative of DNAPL
- Passive injection with direct push borings
- “Pilot” study consisting 250 injection points for delivery of emulsified vegetable oil and microbial culture (35,000 ft²)

Passive Aggression!!

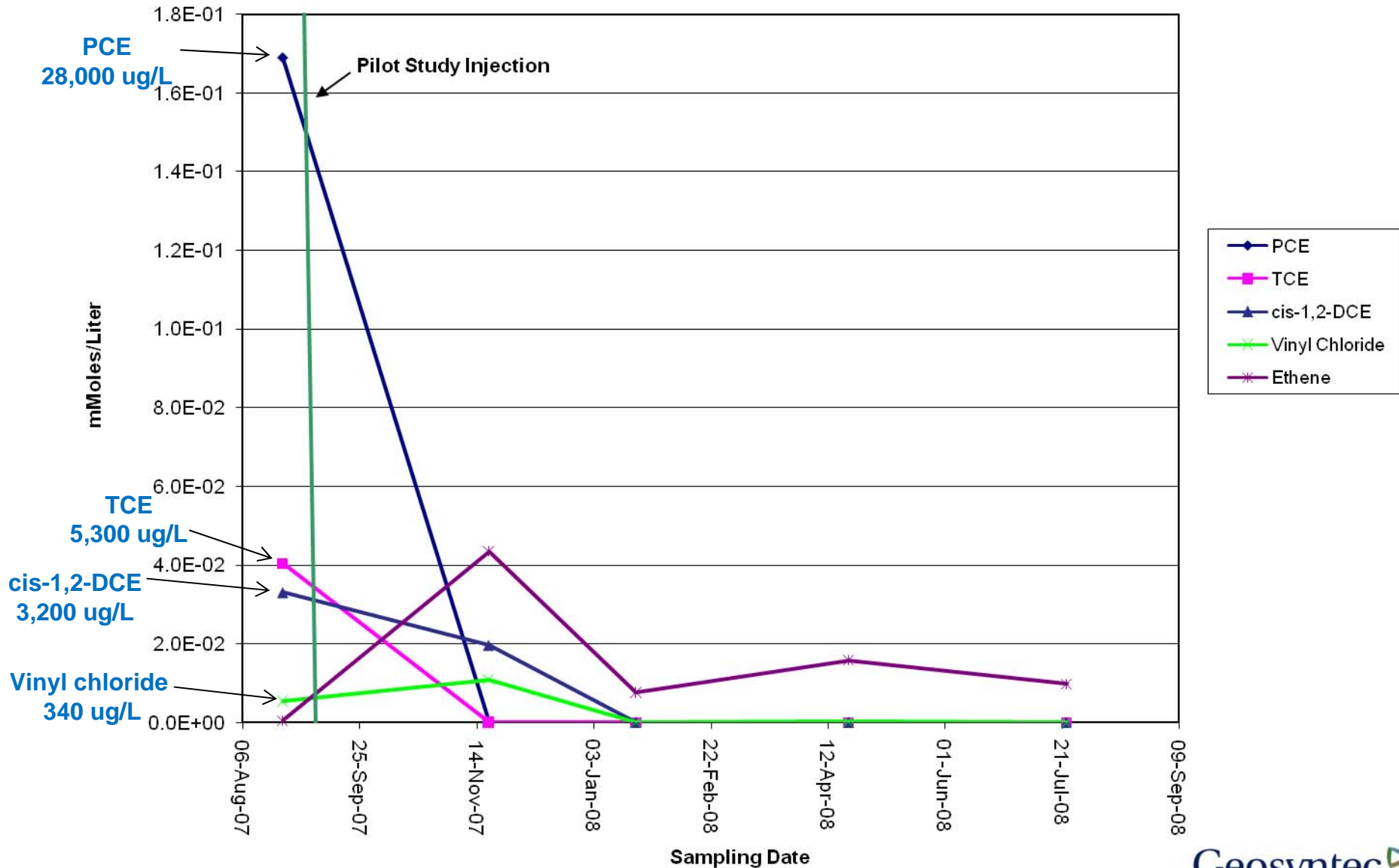


Entire plume
was “dosed”

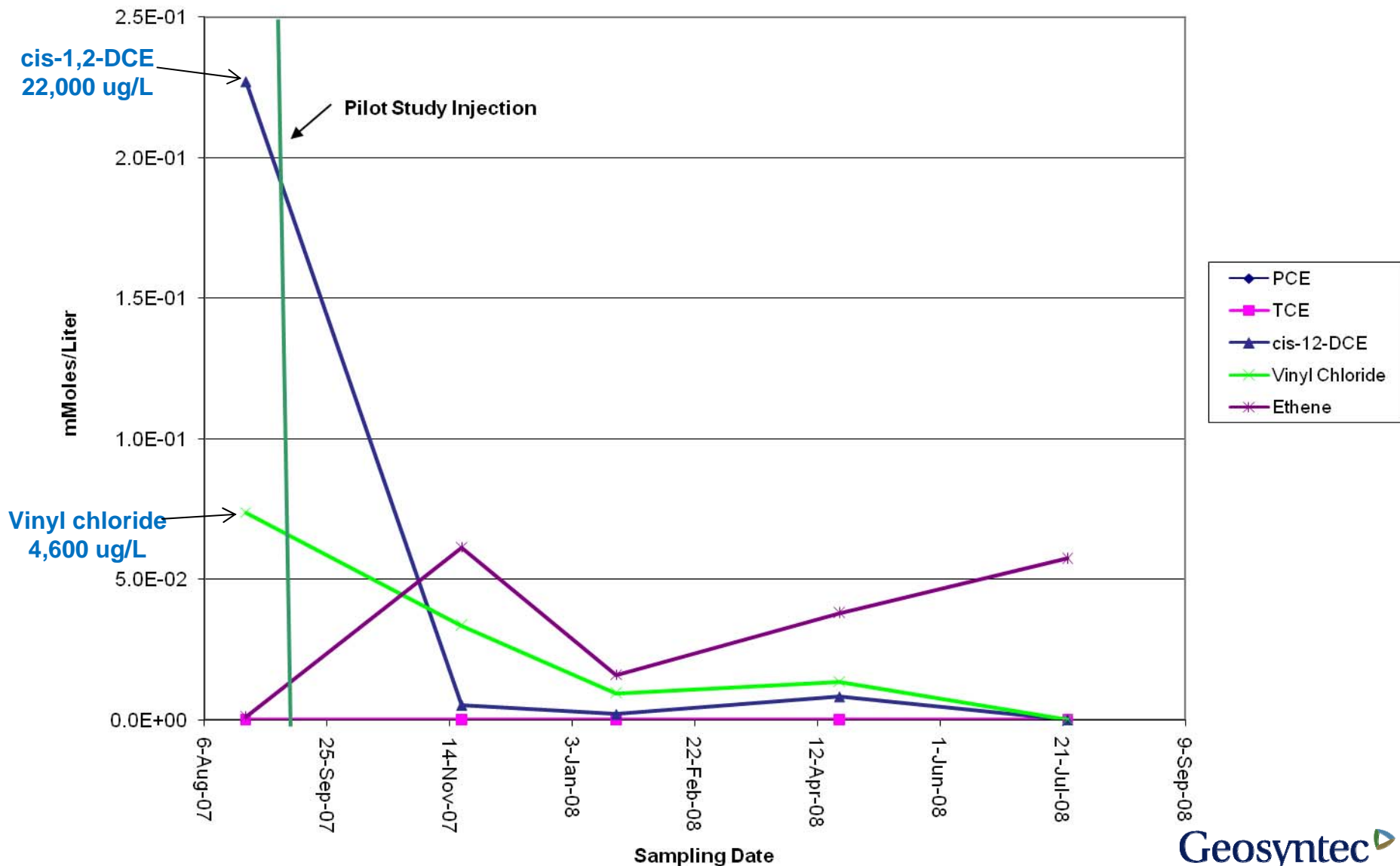
Higher
density in
areas of
potential
DNAPL

Hit Hard, Hit
Once!!

Results-Source Area



Results-Central Area



Aerospace Facility Qualitative Analysis

Conventional Alternative: Excavation/Dewatering

- **Soil: 18,000 cu yd**
 - Excavation, transport/off-site disposal as RCRA haz. 200 miles away, backfill with clean soil
 - GHG emissions from equipment, H&S (higher risk of injury or death from remedy than current risk of contamination)
- **Groundwater: 1.1MM gallons**
 - Extraction and Treatment w/GAC, disposal to POTW
 - GHG emissions from energy use, and loss of resource
- **>\$7,000,000!!**

Aerospace Facility Qualitative Analysis

INNOVATIVE ALTERNATIVE

In-Situ Bioremediation

- Treated same quantity of soil and groundwater in 3 weeks
- Groundwater monitoring: 2 years
- Confirmation sampling
- Enhanced MNA
- <\$500,000

Aerospace Facility Qualitative Analysis

Less Time = Green Remediation!!

- Fixed costs associated with project
- Groundwater monitoring
- Storm water compliance
- Reports
- Meetings
- Need a weighting factor for project duration

Summary of a Consultant's Perspective

- If Time = \$\$\$\$, and more effort = \$\$\$\$, then sustainable remedies by definition = \$
 - Because effort and time often result in spending or consuming more resources to achieve a goal
 - Cost is a simple measure to compare remedies, particularly if remedy has long operational time frames
- Currently, a thorough sustainability analysis takes a lot of effort because there are no clear or universally-accepted metrics/processes for their evaluation
- Only a few categories produce the greatest *quantifiable* impacts
- Some important impacts not currently quantifiable: land use/stagnation, residual waste, habitat alteration, and MEETINGS
- Innovative site characterization and remedial technologies are typically greener than conventional methods

Recommendations

Analysis of Green Remediation should be mandatory but streamlined

- Commence qualitative analysis immediately
- Continue Development of Standard Analysis
- “Lookup Tables” of metrics and impacts per activity should be developed
- Sustainability Analysis should be.....
SUSTAINABLE!
 - Should not be another hurdle that delays and inhibits site characterization and remediation

Recommendations

Update Regulatory Framework

- Abolish RCRA “Listed Waste” classification for hazardous waste
 - Prohibits on-site reuse
 - Inhibits redevelopment
 - Unnecessary excavation/transport/disposal
- Evaluate sustainability of current Risk Thresholds (10E-4 to 10E-6)





THESE DAYS ARE OVER!!